

## CHAPTER 2

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# SCAFFOLDING THE TPACK FRAMEWORK IN READING AND LANGUAGE ARTS

## New Literacies and New Minds

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In his century old seminal essay, *What Knowledge is of Most Worth?*, social theorist Herbert Spencer (1909) stated that this question needed to be answered before designing curriculum or instruction. As we continue into the 21st century, Spencer's compelling question is still front and center but now in the midst of fast-paced technological changes that are prompting new literacies. Perhaps in no other area is his question more provocative than in teacher education. Mishra and Koehler (2006) assert that in teacher education, the successful teacher is one who can draw from content, pedagogy and technology, forming a technological pedagogical content knowledge (TPACK) framework—and that it is *this* knowledge that is of most worth. In essence, effective teaching with technology requires TPACK, or an ability to integrate content, pedagogy and technology flexibly during the act of teaching. They argue that teaching with technology is a “wicked problem” (Rittel & Webber, 1973), with solutions being diffi-

cult to realize because of “complex interdependencies among a large number of contextually bound variables” (Koehler & Mishra, 2008, p. 9). Central to understanding Mishra and Koehler’s TPACK framework is the capacity to separate the three components (i.e., content, pedagogy, and technology) while at the same time understanding that they coexist in a dynamic transactional relationship. For example, when a new technology is introduced it forces teachers to “reconstruct the dynamic equilibrium among all three elements” (p. 18).

In light of the new literacies that are being prompted by emerging technologies, researchers and practitioners are exploring what it means to be literate in the 21st century and collaborating in innovative ways to produce new knowledge for the field. For example, Donald Leu and his colleagues at the University of Connecticut have conceptualized and produced an impressive body of work that addresses new literacies broadly defined (see Coiro, Knobel, Lankshear, & Leu, 2008) as well as the focused area of online reading comprehension (e.g., Coiro, 2011; Coiro & Dobler, 2007; Leu, Kinzer, Coiro, & Cammack, 2004). Prompted by the rich media landscape that exists today, Henry Jenkins and colleagues (2006) have articulated a new skill set that involves social practices developed through online collaboration and networking. These new media literacies, which are contextualized within digital media environments, comprise skills that students need for the 21st century (e.g., play performance, simulation, appropriation, multitasking, distributed cognition). The landscape is quickly being populated with attempts at theorizing new literacies (Alvermann, 2008) and with new educational organizations that conduct research and teacher professional development in the area of new literacies. For example, in 2007 the Friday Institute for Educational Innovation at North Carolina State University launched the New Literacies Collaborative (NLC) with the purpose of connecting researchers and practitioners at the intersection of literacy, technology and media. The NLC focuses its work in three areas: (a) an online ning environment for educators to share best practices and information related to teaching new literacies; (b) a multidisciplinary team that conducts research on new literacies; and (c) teacher professional development in the form of summer institutes and a graduate degree program. (For more information, see [newlit.org](http://newlit.org)).

Clearly, the pressure on teachers to embrace new literacies and to integrate effectively technology in the classroom is steadily increasing. The TPACK framework can be used as a tool to offer insight into how the complexities inherent in teaching and learning with technology can be approached to facilitate teacher growth with new literacies. Coming from a popular press perspective, Daniel Pink in *A Whole New Mind* (2005) boldly claims “the future belongs to a very different kind of person with a

very different kind of mind—creators and empathizers, pattern recognizers, and meaning makers. These people ... will now reap society's richest rewards and share its greatest joys" (p. 1). Whether one considers Pink's assertion valid or not, it is clear that students today have opportunities to learn in different ways from those of previous generations, with much of the change due to advancements in information technologies. Growing trends among students demonstrate increased passion for and reliance on technologies for entertainment and communication (Lenhart, Purcell, Smith, & Zickuhr, 2010); in many instances, technology use outside of school has out-paced technology use within schools (Spires, Lee, Turner & Johnson, 2008).

Teachers' dispositions and uses of technologies to support student engagement with new literacies are central to closing the gap between in-school and out-of-school student technology use. In 2006, Hayes surveyed 2,500 school systems with at least 4,000 students. She found that 23% of school systems were implementing 1:1 computer programs in at least one grade. Forty-eight percent of the school district technology officers surveyed reported that a technology-enabled initiative would be implemented in their schools by 2011. The National School Board Association conducted a survey of all U.S. public school districts and found that 37% have launched technology learning initiatives (2010). Taken together, these findings suggest that 1:1 computing initiatives are steadily increasing across the nation. Learning how to use technology is much different than knowing what to do with it instructionally, as Koehler and Mishra (2008) assert with their TPACK model; just knowing the technology or having technology content knowledge is inadequate for applying technology effectively and helping students learn new literacies. In-service teachers want and need their expertise and past experience to be recognized and connected to challenges of the current learning experience so that it will relate to real life issues and problems they face when integrating technology and new literacies in their classroom (Hughes & Scharber, 2008). According to Harris (2008), in-service teachers need to know why they are learning something and how it will benefit them; in essence, teacher education must be an "act of persuasion" that is both a recursive and expansive process.

Designing a theoretically grounded learning process for English/language Arts (ELA) teachers, which recursively and expansively "persuades" and simultaneously accounts for the multifaceted context of technology integration, is indeed challenging. This was the goal of our study, which was conducted in the context of a graduate level course (i.e., new literacies and media) targeting ELA teachers. Using a mixed-method approach, we attempted to answer the question: *How does a project-based inquiry model assist TPACK development and propel ELA teachers to integrate technology?* Our

research question is supported by three theoretical positions that are discussed in the following section.

### **TPACK, DISTRIBUTED COGNITION, AND INSTRUCTIONAL SCAFFOLDING: THEORETICAL PERSPECTIVES**

Three bodies of literature provide a theoretical foundation for the current study: (a) Mishra and Koehler's TPACK, as it applies to ELA instruction; (b) distributed cognition, which offers a lens to view how ELA teachers combine their individual cognitions with group cognitions to create understandings that enable them to advance their TPACK framework; and (c) instructional scaffolding based on the Vygotskian perspective of gradual release of customized support. These theoretical perspectives are discussed within the context of a project-based inquiry (PBI) model (see Figure 2.1) that was used to engage ELA teachers in the use of technology in their classrooms.

#### **TPACK**

In the current explosion of technology applications for education, instructional practices as well as underlying pedagogical beliefs require redefinition and redesign. Koehler & Mishra (2008) suggest that redesign must include an in depth understanding of the complex relationships among technology, content, and pedagogy; further, in depth understanding must be aligned with content-specific instructional strategies and learner outcomes. Of late, significant interest has emerged for examining TPACK as a framework that captures the complexity of teaching effectively with technology (Harris, 2008; Neiss, 2005; Pierson, 2001; Webb & Cox, 2004). TPACK arises from a distinct overlay among content, pedagogical, and technological knowledge. Likewise, teachers need to understand educational technology applications deeply and flexibly so they can help students. Teachers need to see how technology can create connections among content areas and to everyday life for their students. This kind of understanding provides a foundation for new pedagogical outcomes that will enable teachers to effectively teach in the 21st century.

To characterize the complex ways in which teachers think about how particular content should be taught, Shulman (1986) argued for "pedagogical content knowledge" as a framework that captures the teaching process. Since the 1980s, Shulman's model of teacher knowledge incorporating the construct of pedagogical content knowledge (PCK) has had an important impact in the field. Shulman defined PCK as "that amalgam of



content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding" (p. 8). He also highlighted teachers' representation of content knowledge in teaching as follows: "It represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners and presented for instruction" (p. 8).

Shulman generated a boom of research on teachers' knowledge of their subject matter and the significance this knowledge has for successful teaching. In Shulman's theoretical framework, teachers need to master two types of knowledge: (a) content, also known as "deep" knowledge of the subject itself; and (b) knowledge of the curricular development. Especially important is content knowledge that deals with the teaching process, including the most useful forms of representing and communicating content and how students best learn the specific concepts and topics of a subject. ELA teachers are responsible for a substantial breadth of content. These teachers may be responsible for teaching many connected disciplines, such as: literature, different genres of writing, grammar, theater, speech, journalism and debate. The challenge for ELA teachers is developing the three conceptual areas of technological pedagogical knowledge (TPK), technological knowledge and technological content knowledge, specifically making connections among technological tools, ELA content and instructional practice (Hughes & Scharber, 2008). Preparing ELA teachers' to embrace the complexities associated with TPACK development requires learning opportunities that expressly use ever-emerging technologies associated with their content that subsequently promotes student learning.

The TPACK framework adds teachers' technology knowledge to Shulman's well-established PCK framework. Pierson (2001) attempted to discover if exemplary use of technology was comparable to indicators of pedagogical expertise. She was one of the first researchers to suggest that further study about different connotations for "technology integration" was needed and proposed adding the technology knowledge component to Shulman's Pedagogical Content Knowledge (PCK) Framework. Pierson's work is significant because it is among some of the first literature that clearly demonstrates a need for an operational definition for "technology integration" as it applies to classroom teachers. She approached the creation of an operational definition by having each of the teachers in her study provide varied definitions for technology integration. These results provided an anchor for the initial conceptualization of a new pedagogical construct in relation to teachers' use of technology.

The TPACK framework radiates with opportunities to deepen teacher's reflections to possibly reshape their long held beliefs and practices regarding pedagogy, content, and technology (Mishra & Koehler, 2006). Teachers

must begin to cognitively consider their own professional knowledge to create openings for the development of their TPACK; informed development of TPACK may ultimately lead to better technology integration by teachers. In 2003, Mouza attempted to identify effective ways to improve teachers' technological skills and technological pedagogy. Her case studies revealed that professional development for technology integration helped teachers become "aware" of new pedagogical strategies associated with the use of technology; however, teachers did not change their pedagogical approaches when integrating technology. This study highlighted the ongoing struggle to help teachers transform their pedagogical stances. Using the PBI model, we attempted to scaffold the actualization of technology innovation in classrooms and the development of teachers' TPACK.

### **Distributed Cognition**

The PBI, which was the primary pedagogical tool used during the course, is grounded in the theoretical framework of distributed cognition—a framework that situates learning in a social context where learners are engaged in shared cognitive activities mediated by technological tools, artifacts as well as human interactions (Hutchins, 1995; Salomon, 1993). Salomon (1993) asserts that individual and distributed cognitions can be viewed as separate phenomena that exist in an interdependent dynamic interaction. For example, individuals working together on a collaborative assignment, such as the PBI, possess different kinds of knowledge and so engage in interactions that allow them to pool their intellectual resources to accomplish a learning goal. Collaborative learning requires the negotiation and coordination of group members' diverse perspectives and presumes at least some amount of shared understanding. Central to acquiring shared understanding is the capacity to make one's own thinking visible as well as accurately interpret a partner's cognitive processes. Roschelle (1992) found that negotiated meanings form a basis for shared understanding and can be used as shared reference points during the construction of new knowledge in novel learning situations. The process of constructing a shared understanding has the potential to catalyze creative problem solving and higher levels of thinking, but often the process needs to be scaffolded in order to produce desired learning results.

### **Instructional Scaffolding**

With the increased popularity of inquiry learning, scaffolding is frequently used to describe how students are provided instructional support

during learning. Referencing the theoretical definition and progression of reading comprehension processes, from behavioral to cognitive to sociocognitive, Spires and Estes (2002) proposed the evolving theoretical domain of Web transactions and argued that students need various types of scaffolding when reading on the Web. Web transactions imply the theoretical juxtaposition of Rosenblatt's (1978) time-honored reader-text transaction to include the salient features that Web-based reading affords. According to Vygotsky (1978), there are three levels of student performance: (a) that which students can accomplish independently; (b) that which students can accomplish with the assistance of someone more knowledgeable; and (c) that which students cannot accomplish. The area between the two extremes is called the zone of proximal development defined as the distance between the actual level of development as determined by independent problem solving and the level of potential development as determined by problem solving under adult guidance or in collaboration with more capable peers (Wood, Bruner & Ross, 1976). Scaffolding is valued because it helps the student master the task, strategy or skill using easier material, and then moves toward mastery of higher level content with more confidence and actual understanding. In addition to such scaffolds, it has been suggested that students benefit when given access to relevant task-specific information needed to perform complex learning tasks and ultimately learn from them. One way to present this necessary information is to introduce it when the students require it as they are performing a certain task (Sherin, Reiser, & Edelson, 2004). This just-in-time presentation of information can be supportive and procedural, thus helping students monitor their own thinking, gain new knowledge, and revise existing schemata with the aid of cognitive scaffolds.

The original idea that scaffolding occurs between individuals has been expanded to include artifacts, resources (including technology), as well as environments (Sherin, Reiser, & Edelson, 2004). During the PBI, students are placed in dyads as they conduct their project and they experience different levels and types of scaffolding. For example, scaffolding is provided directly from the instructor through ongoing feedback on assignments within the PBI process. Additionally, scaffolding is provided through collaboration in the dyad and in larger group interactions that are structured as face-to-face exchanges and as online interactions within the course Moodle. The comprehensive scaffolding intervention possesses several pedagogical features that contribute to its proposed viability. First, through customized support, the scaffolding intervention fades as the student increases independence with the use of technological tools embedded within the inquiry process. Second, the scaffolding intervention surrounds the learning task by being available to the student before, during, and after learning. Third, the scaffolding intervention makes the tar-

geted strategies explicit so that the student can engage in metacognitive activity that is essential for acquiring more control with technology integration.

## METHOD

### Participants

Participants included 20 in-service teachers who were enrolled in a graduate course on literacy, technology and media that employed a project-based inquiry learning approach. The demographic composition of the class included 19 females and 1 male; 16 Caucasians, 2 African Americans, and 2 Asian Americans. Participants ranged in age from 23 to 54 years old with the average age being 30. Teaching experience ranged from 13 teachers who had taught for less than 5 years, 4 teachers who had taught for 7 years, and 3 teachers who had taught over 10 years.

### The Project-Based Inquiry (PBI) Model

The graduate course employed a hybrid model for instruction that coupled the Moodle course delivery environment with face-to-face interactions. The course provided a rich learning experience in which teachers: (a) learned about new technologies; (b) designed specific ELA lessons that incorporated the new technologies; and (c) implemented the lessons in their classroom. They learned about new technologies (e.g., Voice-thread, Animoto, video production, wikis, nings) and accompanying pedagogies through resources housed in the course Moodle. They worked in dyads in a design studio environment, which fosters collaboration and access to technology tools and scaffolded support. Teachers used this time to design and implement innovative lessons to be used in their classrooms using a project-based inquiry approach. This particular PBI approach has been used in a variety of instructional contexts that target: in-service teachers (Spires, Lee, Young, Leu, Coiro, & Castek, 2009); teachers enrolled in a graduate degree program (Manfra & Spires, 2012); and middle grade students (Spires, Hervey, Morris, & Stelpflug, 2012). Teachers in this study use the PBI process to create their project that results in a short video documentary directed to a professional audience. The PBI (see Figure 2.1) included the following 6-phase process:

1. **Ask a Compelling Research Question.** In collaborative dyads, teachers were required to ask a question that integrated the areas



of new literacies and technological pedagogical content knowledge (TPACK). They generated a specific question that was addressed through an inquiry process. Following are four sample questions: (a) How can blogging about young adult novels engage students in classroom discussion and improve their reading comprehension?; (b) How can Voicethread be used to increase student engagement with poetry?; (c) How can virtual literature circles using Webcams and collaborators at different schools facilitate literary reading and learning?; (d) How can the use of Flip cameras and video production facilitate students' use of the writing process?

2. **Gather and Analyze Information.** Based on their question, teachers conducted research with the aim of creating an innovative lesson that integrated the areas of new literacies and their TPACK. The goal for the teachers was to be intentional about designing and implementing a lesson that stretched their instructional capacity, pushing them beyond their comfort level with technology. They reflected on their lesson by addressing the following questions: What literacy/learning theories grounded your lesson? What new tools did you employ in your lesson and how did they impact your TPACK? What were the learning outcomes for your students and for you as a teacher? Evaluate the collaboration experience with your dyad partner? What challenges did you encounter—both internal and external? How did you address the challenges? What will you do differently for the next lesson?
3. **Creatively Synthesize Information.** In order to arrive at a creative synthesis, teachers engaged in an iterative design and development process that resulted in representing their research results in a new and original way. The process required them to demonstrate complex thinking with their content by integrating information across multiple texts (print, web-based, and video), drawing inferences, summarizing, and making novel connections for their video product. Starting with a storyboard, which included a written script paired with video and/or images, teachers made sure their plan reflected high intellectual, aesthetic, and technical quality. They gathered necessary music, narration, video, and images as well as made sure to comply with copyright and fair use law. They used Movie Maker or iMovie to create a 5-minute video that reflected their PBI process, including aspects of their classroom lesson, as a final product of learning. Each dyad received a PBI toolkit to help facilitate their video production experience. See Figure 2.2 for toolkit content.

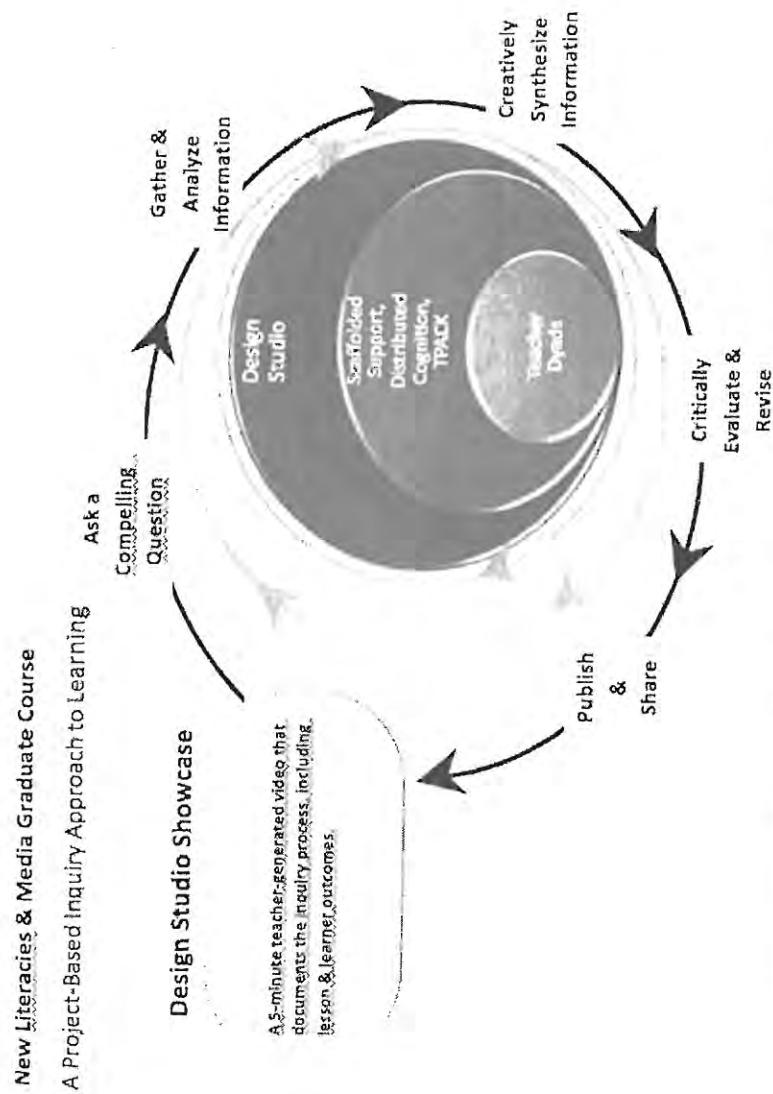
4. **Critically Evaluate and Revise.** To ensure broad based and high-level feedback for their video products, teachers engaged in a 3-part evaluation: self-evaluation, peer evaluation, and outside expert evaluation. Evaluations were based on the following rubric elements: (a) Intellectual Quality, which included clear purpose, synthesis and construction of ideas, appropriate curriculum connections, clear beginning and ending, and sources cited appropriately; and (b) Aesthetic and Technical Quality, which included camera techniques, editing/transitions, audio (music and dialogue), and creativity/originality. Using multiple sources of feedback based on a the evaluation rubric, teachers were directed to revise their video production accordingly.
5. **Publish and Share.** As a culminating activity, teachers shared their videos with class members as well as the larger educational community, on the Friday Institute's New Literacies Collaborative Ning ([newlit.org](http://newlit.org)). In creating a video of their PBI and sharing it through Web 2.0 technologies, teachers were afforded the enriched opportunity of engaging in intellectual discourse around their PBI products that extended beyond the course they were taking. As they shared their products virtually, they received additional feedback from new colleagues who were part of a larger professional learning community as well as from colleagues in their immediate networks.

### Procedures and Data Sources

Using a mixed method research design (Creswell & Plano-Clark, 2006), data for the study was collected from three sources: (a) a teacher survey that assesses teachers' beliefs about technology use (Ertmer, 2005; Fang, 1996; Park & Ertmer, 2007) that was administered at the beginning and end of the course; (b) an exploratory visual representation and analogy exercise that attempted to capture changes in participants' views of their TPACK; and (c) teacher-generated reflections that were captured on an online forum within the course Moodle.

#### *Teacher Survey*

Teachers' beliefs were examined via the Teachers' Beliefs Regarding Technology Use Survey, which is a 54-item survey composed of three sub-components: teachers' pedagogical beliefs, teachers' self-efficacy beliefs for using technology, and teachers' beliefs about the perceived value of computers for instructional purposes. For reliability and validity data related to the development of the survey, see Park and Ertmer (2007). All

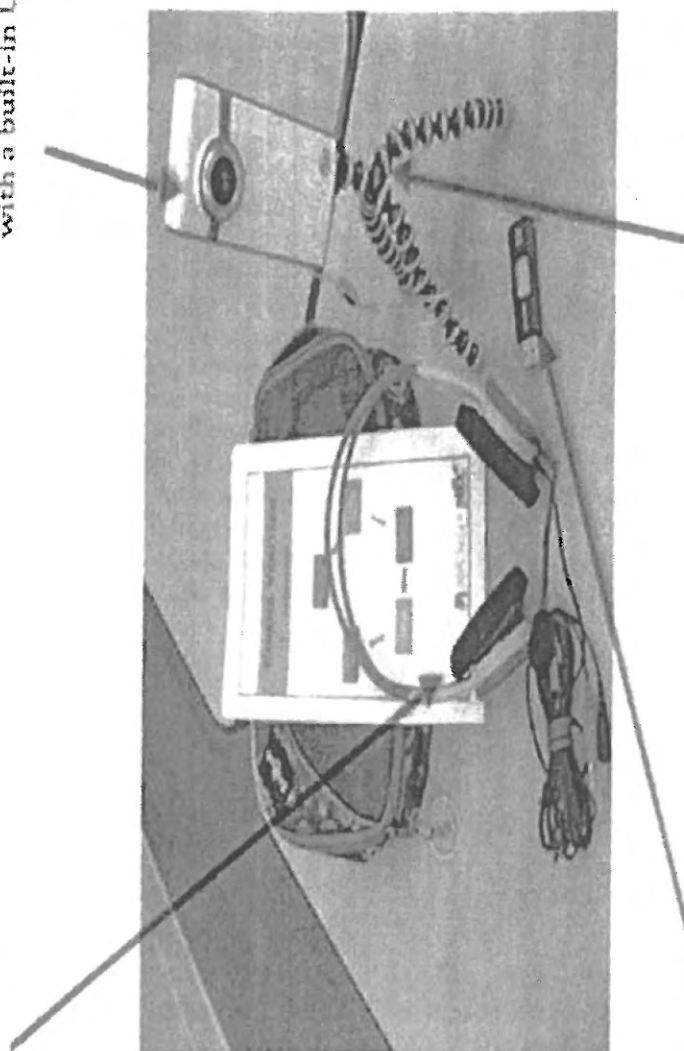


Source: Diagram adapted from New Literacies Teacher Leader Institute (Spires et al., 2009).

Figure 2.1. Project-Based Inquiry (PBI) model.

**Headphones - Hands-Free  
Monaural PC Headset**

**Flip Camera- A small,  
affordable video camcorder  
with a built-in USB.**



**1GB Flash Drive USB-  
Personal and portable  
storage device**

**Gorilla Pod- Lightweight,  
compact, portable, bendable,  
rearrangeable, and storable tripod.**

Figure 2.2. Project-Based Inquiry (PBI) kits.

items were presented in a 7-point rating scale; students were asked to rate their level of agreement from 1 (*completely disagree*) to 7 (*completely agree*). Additionally, two researcher-generated questions were added to the survey that asked participants about their level of technology use for instructional purposes in the classroom and their level of technology use outside the classroom. The survey was administered online at the beginning of the course semester and again at the end of the semester 14 weeks later.

### ***Teacher-Generated Analogies***

The use of analogy in developing understanding of phenomena is not new in education. Dreistadt (1969) catalogues the central role of analogies in the history of scientific ideas, including the works of Einstein, Darwin, Bohr, Mendeleev and Kekule. Analogies act in a special way by addressing complexity or novelty via engaging in a comparison with common sense knowledge or experience. This often calls for an imaginative, intuitive leap on the part of the learner. Thus, an analogy exercise has the potential to mediate a metacognitive transfer for newly developed insights for TPACK. Analogies can be an innovative pedagogical tool because the learning process usually involves some element of comparing what we don't know with what we do know. Bailey (2003) indicates that using analogies is a powerful technique in explanation and, combined with a visual illustration or demonstration, can stimulate significant new learning or transform previous knowledge. We based our procedure loosely on the model of Synectics (Gordon, 1961); the term comes from the Greek "syn" and "ektos," and refers to the fusion of diverse ideas (Nolan, 2003). In his application of Synectics, Gordon (1961) used three forms: direct analogy, personal analogy and compressed conflict.

As an exploratory measure, we asked teachers to use one aspect of Synectics—creating a personal analogy; in this case they created an analogy about their TPACK development based on a visual stimulus. At the beginning of the course, teachers were asked to peruse an archive of pictures located in Voicethread—choosing the one that they could relate to in terms of their current capacity to use and integrate technology into their instruction. They reflected on how the picture visually represented or reminded them of their current experience with using technology in their class. This reflection was captured orally or in writing within Voicethread as a companion to the targeted picture. We anticipated that the recapitulation of an analogy and subsequent comparison with a previous analogy might provide evidence of deeper interpretation and meaning within the context of TPACK development, perhaps uncovering the journey toward a better conceptual understanding for in-service teachers.



***Teacher Online Reflections***

Particular emphasis was placed on teachers' perceptions about the relationship between specific course activities and their TPACK development. Data analysis focused on teachers' responses to open-ended questions posed in weekly online forums throughout the semester. Two researchers independently read the forum responses and targeted initial topics based on the frequency with which participants mentioned particular topics. These topics included: evidence of scaffolding, evidence of TPACK development, shifts in teachers' roles, shifts in teachers' beliefs, and other. The initial topics were collapsed by similarities and the data were reread and recoded. During this second reading, a small number of new topics emerged and were coded in a third data reading session. The researchers then clustered the coded data into themes and made decisions about which themes to include in the study, based on relevance to the research topic and volume of responses aligned with a particular theme. In all, 12 codes were established and 3 interpretive themes emerged from the data.

**RESULTS**

Quantitative results from the teacher surveys, qualitative results from the TPACK analogies, and qualitative results from teacher online reflections are reported separately in the results section. Results should be interpreted within the context of the intact sample of participants and the potential limitations a study of this kind presents. For example, we used a pre/post design to assess attitudes of the teachers enrolled in the graduate course based on a survey; within the context of this study, the survey results are used heuristically and cannot be interpreted empirically since our study did not include a control or comparison group.

**Results From Teacher Surveys**

To examine if attitudes toward technology had changed over the course of the class, paired *t*-tests were conducted between preclass and postclass survey responses. As seen in Table 2.1, analyses indicated that postclass ratings were higher than preclass ratings in all five areas. Postclass ratings were significantly higher than preclass ratings in two areas: teachers perceived values of computers for instructional purposes,  $t(19) = 2.48, p = .02$ ; and teachers' perception of their in-class technology skills,  $t(19) = 2.10, p = .05$ .

**Table 2.1. Descriptive Statistics of Variables**

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Range</i>	<i>N</i>
Preclass measures				
Pedagogical beliefs <sup>1</sup>	4.23	0.52	3.06-4.94	20
Self-efficacy for integrating technology <sup>1</sup>	5.78	0.77	4.00-7.00	20
Perceived values of computers for instructional purposes <sup>1</sup>	5.00	0.84	3.27-6.82	20
Technology skills in the classroom <sup>2</sup>	1.90	0.55	1.00-3.00	20
Technology skills outside of the classroom <sup>2</sup>	2.35	0.67	1.00-4.00	20
Postclass measures				
Pedagogical beliefs <sup>1</sup>	4.32	0.39	3.71-4.91	20
Self-Efficacy for integrating technology <sup>1</sup>	5.92	0.68	4.86-7.00	20
Perceived values of computers for instructional purposes <sup>1</sup>	5.47	0.61	4.36-6.55	20
Technology skills in the classroom <sup>2</sup>	2.25	0.79	1.00-4.00	20
Technology skills outside of the classroom <sup>2</sup>	2.55	0.61	2.00-4.00	20

Note: <sup>1</sup>From the teachers' beliefs regarding technology use survey (Park & Ertmer, 2007).

<sup>2</sup> Investigator initiated questions.

## Results From TPACK Analogies

As previously mentioned, we asked teachers to create an analogy about their TPACK development based on a visual stimulus. At the beginning of the course, teachers were asked to peruse an archive of pictures located in Voicethread—choosing the one that they could relate to in terms of their current capacity to use and integrate technology into their instruction. They reflected on how the picture visually represented or reminded them of their current experience with using technology in their class. This reflection was captured orally or in writing within Voicethread as a companion to the targeted picture. All twenty teachers demonstrated some type of growth in terms of their TPACK development from the first time they verbally created their analogy at the beginning of the semester to the time that they revisited their analogy at the end of the semester. By growth, we mean that the language they used demonstrated new insights about technology or increased efficacy about their capacity to successfully use technology. Figure 2.3 presents three examples in which teachers clearly developed an analogy based on the visual stimulus and connected various aspects of their TPACK development to their interpreted visual meaning of the picture. Note that in the first analogy, the teacher alluded to the value of working in a team and collaborating, connecting her think-

Pre-Course	Teacher-Generated Analogies - Initial	Teacher-Generated Analogies - Revisited
Visual Stimulus	I chose the image of the meerkats to represent my standings on the TPACK framework. There is a show on animal planet called Meerkat Manor. The first time I saw this show, I was hooked. I watched in amazement as these animals survived while relying on each other. They work as a team although they have a specific pack leader. I feel that I cannot make this journey through TPACK on my own. Meerkats are always on guard and checking their surroundings. I feel that this stance is closely correlated with technology integration - you always need to be on alert so that you are not blindsided by new technologies that are thrown your way.	This class has increased my TPACK in many ways. I still feel that I can relate to the meerkats working as a team. They are always there to have each other's back and protect each other. I feel that this will always be the case with teachers as they incorporate and learn technology. It may be me asking another teacher for help in reference to technology, or I may be the one to provide the support to team members. My confidence has increased with using technology in my classroom. I feel that in a way, I can become a pack leader for other teachers at my school. Every teacher needs to take steps toward incorporating technology into the classroom. Giving each other encouragement along the way is what will make the biggest difference. Technology is not something teachers will be successful with if they are alone.
	This sliver of a new moon represents my current state of mind in exploring the TPACK model. The small, but bright light reflecting from the moon's surface is like a series of idea lightbulbs turning on in my brain. The lighted surface of this moon will continue to grow as the moon waxes during its lunar cycle. So, too, will my new ideas continue to multiply until the individual lights amalgamate into the whole, cohesive thoughts of a full moon. There are a few clouds ahead as I work through challenges, but these difficulties will not prevent me from moving towards achieving my full moon of understanding, accomplishment, and technological integration.	In looking back at my initial reflection on my TPACK development, I can see that I was more optimistic about my ability to overcome certain hurdles. While I have become more self-sufficient and self-confident in my use of technology over the course of the semester, I also find I am increasingly more frustrated by the lack of technology at my school. There are so many excellent technology tools that are simply beyond my reach because I do not have the physical hardware and support to use them. Dr. Spires encourages us to be catalysts for change and teacher leaders at our own schools. She asserts that we continue to voice our desires for more technology and document the ways in which it has enhanced student engagement and learning in our classrooms. I hope I can live up to this call order!
	I chose the image of the man on the edge of the cliff. It seems to me that he is hanging on for dear life afraid of falling. This is the way that I feel about TPACK. I am afraid to take the plunge. I'm afraid to lose control or to try something new and innovative. The cliff represents my way of teaching--content and pedagogy. Beyond the cliff's edge there are new technologies, pedagogies, and content. The man is afraid to "let go." As a teacher, I'm afraid of making mistakes with technology--would I appear "uneducated" to my students? I should be the expert in the room, right? Also, I am hanging on to that cliff because I was not taught with a lot of technology, and I certainly wasn't taught with the creative, innovative technologies that we have today! I feel comfortable with my pedagogical and content knowledge since I have had 7+ years of teaching experience. But I'm a lost soul when it comes to technological knowledge.	What is that old saying: "You've come a long way baby..." Well, I know that I have come a long way during this course, when it comes to technology. Instead of "holding on for dear life," I feel like I have begun to take the plunge. If I haven't jumped right off the cliff, I have at least tested the water to see if it is hot or cold. This class has increased my TPACK knowledge by introducing me to numerous tools that I can use in my language arts classroom. Also, I have become excited about technology. After seeing my students complete their book trailer videos, I see how enthusiasm can spread from the students to me. And I found out that it is all right for the students to distribute their knowledge to me. I learned that I don't have to know everything, and through a collaborative teacher/student effort, we can do a lot with technology! Finally, to reflect, I know that I cannot continue teaching the way that I was taught. The truth is, I was not a 21st century learner so I cannot expect my students to learn the same way that I did--they need technology integrated in daily lessons much more than I ever did.

Figure 2.3. Teacher-generated analogies at the beginning and end of the course.

ing to how meerkats rely on each other. In the second analogy, the teacher used the idea of the moon waxing during its lunar cycle and how she could see her knowledge and experience with technology evolving to full moon status. The third analogy alluded to the teacher acknowledging her fear of the unknown and feeling like she was standing on a cliff afraid to jump off into the world of technology.

### Results From Teacher Reflections

As previously discussed, 12 codes and 3 themes emerged from teacher response data. The interpretative themes that developed from the teach-

ers' replies were: (a) New Attitudes: *"I Can't Turn Back Now,"* (b) New Negotiations: *"It's OK Not to Know Everything,"* and (c) New Cognitions: *"I Can Actually Feel My Brain Changing."*

***New Attitudes: "I Can't Turn Back Now."***

The effective attitudes and actions employed by teachers ultimately can make a positive difference on the valuable development of their TPACK and subsequent successful use of technology in their classroom. A new attitude for TPACK was made clear in this way: "I would describe the progress I've made in my TPACK development alliteratively with the words 'Comfort,' 'Confidence,' and 'Courage.' I have newfound confidence that I can use technological tools and resources effectively." One teacher revealed her change in attitude by sharing, "I also understand the importance of incorporating technology into my daily lesson plans to help my students conceive and appreciate the meaning of a 21st century learner." Several other teachers underscored the fact that they had acquired a sense of urgency about helping their students become 21st century learners and that their new found attitude about the role of technology was a driving force.

Shifts in attitude can often lead to tangible actions and changes in teacher practices. Several teachers highlighted some of their new practices; one teacher stated, "I've learned many new tools to use in my classroom that are not difficult to integrate. Wordle and VoiceThread are just a couple of the tools in which I'm now familiar with and use in my own classroom." Another teacher illustrated her new instructional practices as they related to specific ELA outcomes when she explained, "In my classroom I have now incorporated technology such as Audacity to increase fluency and comprehension skills, Wordle to summarize text, E-books to publish student stories, a Flip camera for personal reflections, and VoiceThread to practice self-reflection." Yet another teacher voiced her anxiety about being able to sustain her newly developed enthusiasm and skill set: "I love how I felt my attitudes change about technology as the course continued. I know I can't turn back now. My only fear is that without ongoing support I may slip back to old ways of teaching. I hope not for my sake and for the children." Yet another teacher was encouraged with her new found TPACK, but also acknowledged her new found sense of responsibility: "For every moment of inspiration I experienced in this course, I also had a moment of slight anxiety realizing that I was unsure of how I could implement each new idea we were learning. I guess the old saying 'ignorance is bliss' could be applied in my situation. Now that I have new knowledge and awareness, I also carry the personal burden of determining how to use it in a meaningful way." Clearly, this teacher was conflicted about her newly acquired insights.

A teacher's attitude and actions can never be underestimated. In the 21st century, teachers need to be risk takers by trusting their abilities to aptly use new technologies to further student learning. Thus developing appropriately constructive attitudes about using technology becomes vital for this generation of teachers to successfully navigate technological changes in the classroom. It was evident from our data analysis that new attitudes on the part of the teachers were directly related to the support they received as they blazed new trails with technology.

***New Negotiations: "It's Ok Not to Know Everything."***

There is an increased need to more fully understand professional communities as promising models for teaching and learning. In this study, teachers sought help from each other as they navigated the intricacies of attempting technology integration in their classrooms. Most of the teachers in our study acknowledged requiring more support when facing challenges for effectively integrating technology in their classrooms. As previously mentioned, Vygotsky (1978) defined scaffolding instruction as the role of teachers and others in supporting the learner's development and providing support structures to get to that next stage or level. One of the primary benefits of scaffolding instruction is that it engages and propels the learner. The learner does not passively listen to information presented; instead, through prompting, the learner builds on prior knowledge and forms new knowledge. For example, as the teachers collaborated on the PBI, it was apparent that different teachers possessed different kinds of knowledge and so they engaged in interactions that allowed them to pool their intellectual resources to complete their projects. In essence, expertise was distributed among the teacher participants, the professor, outside experts, online resources, as well as the teachers' students. A key aspect of the scaffolding process during the PBI was recognizing how expertise was distributed and then intentionally taking advantage of the expertise that was available (i.e., how to use new tools, how to apply new content, how to empower the learner). We specifically modeled this process for the teachers so that they would not assume that all of the knowledge and expertise resided with the professor. This was an essential element of negotiating the learning process in new ways since the teachers would not be able to know everything about integrating technology in their lessons before they actually had to implement. They needed to understand that they could go forward with a lesson even if they were not completely comfortable with every aspect of the process; and that it not only was acceptable to rely on others for help but highly desirable.

Teachers quickly recognized their students' expertise; one teacher explained, "I learned that it is okay to learn technology through my stu-



dents' experiences. It's ok not to know everything! They love sharing the knowledge that they have with me, and trust me, they have a lot more than I do." Not surprisingly, the teachers acknowledged the value of sharing their newfound knowledge with their colleagues: "I find myself now excited about all of the cool new resources that I have in my pocket and I find myself sharing with other teachers and getting other people excited about using these resources for the classroom. It is not enough for me to be the only person at my school with this knowledge." Another teacher added, "I also have found that my fellow teachers are now experimenting with different technology tools that I have introduced to them. I enjoy being a leader in this way." Teachers have long been collaborating closely with each other to facilitate effective learning for their students. In this study, one teacher summed up her collaborative experience in this way: "Collaborationwise, I was able to work with other teachers and professors who have experienced the tools, which privileged me with first-hand information about successes and challenges." Collaboration appeared to take on new life when teachers incorporated technological tools into their classrooms.

***New Cognitions: "I Can Actually Feel My Brain Changing."***

Many teacher responses indicated an urgent need for being pushed into new ways of teaching in order to meet the challenges of the 21st century learner. As one teacher put it:

The tools that I have learned to use in this class have pushed me into a new way of approaching teaching. In the past I thought I was doing an adequate job of incorporating technology and providing opportunities that were authentic learning experiences for my students. Through reflection, I realized now I am doing a much better job of including technology into my weekly lesson plans, and that did not start until I was educated about how to thoughtfully approach my ELA content in light of technology options.

While many teachers focused on new learning garnered from guided exploration of technological tools throughout the semester, they also delineated the impact of the PBI process. Several teachers indicated that the PBI process helped them gain new understandings about specific aspects of a lesson that must be considered when designing a technology-integrated lesson. For example, teachers must be sure that the lesson is aligned with local ELA curricular goals (i.e., content is important); the technology tools must be in place, tested, and ready to go; if the technology does not work, there needs to be a back up plan in place; if video is used parental permissions must be obtained; and the lesson must be orchestrated with a combination of instructional guidance and student choice. Teachers commented that they already incorporated many of the

planning steps but when technology was added much more front-end planning was required. According to one teacher, "PBI started me thinking about what technologies I can use for my future classes, and what technologies can help students understand more." Another teacher went further, "During the PBI process we were able to reassess and construct new pedagogical knowledge as a result of integrating technological tools to assist in teaching our curriculum." Another teacher emphasized links between technology and curriculum, "Integrating technology with our current students (as part of the PBI) helps us identify what parts of our curriculum content fit well with these technology tools as well as what specific skills will be more successfully mastered with the implementation of technology."

Further, the data revealed that teachers' understanding of the complex relationships among content, pedagogy, and technology were developed during their participation in the PBI and other instructional activities. As previously mentioned, TPACK is at the intersection of three knowledge components, specifically, content, pedagogy, and technology (Mishra & Koehler, 2006). One teacher affirmed, "I have felt growth in my understanding of the connections and interactions among the three components of TPACK. I have a stronger understanding of the importance of treating technology, pedagogy and content knowledge in an integrated manner and not as separate knowledge bases." For this teacher, technology is no longer just an add-on.

Teachers expressed the desire to develop their TPACK deeply and flexibly so they could help their students. They reported about newly constructed connections within their TPACK. As one teacher said, "By testing these tools in my own classroom with my current students, I was able to refine my pedagogical knowledge about how to use the tools effectively." Another teacher added, "As my knowledge of technology tools grew, my knowledge of the content areas broadened. I began to think about how to teach the curriculum in different ways. Each time a new tool was introduced, I immediately found myself thinking about how I could apply it in my own classroom to enhance my students' reading and writing. Thinking about TPACK pushes me to look at the curriculum in a different light. I can actually feel my brain changing." Although this teachers' description may sound hyperbolic, it is conceivable that she was experiencing the disequilibrium that accompanies application of TPACK.

Educational research and practice make it clear that we need to continue to redefine, redesign, modify and otherwise support the ways in which teachers' attempt technology integration in their classrooms. This kind of understanding provides a foundation for new pedagogical outcomes that will enable teachers to effectively teach in the 21st century. Teachers' reflections provided evidence that they were making connec-

tions between the tools they were learning about and how their pedagogy needed to change to accommodate new ways of learning. Through exposure to the concept of the TPACK framework as well as the subsequent scaffolding through the PBI process, it appeared that teachers were able to accommodate and adapt TPACK into their existing instructional framework as well as demonstrate a new mind-set about effective technology integration.

## DISCUSSION

Through information from three data sources—teacher survey, teacher-generated analogies, and online reflections—this study attempted to answer the question: *How does a project-based inquiry model assist TPACK development and propel ELA teachers to integrate technology?* In the discussion section, we advance two culminating themes that emerged from synthesizing results across the three data sources: (a) Technology Use Facilitates Student Learning and Creativity; and (b) Teachers Create New Educational Futures through Innovation and Collaboration. Additionally, we explore some of the challenges that educators face as they strive to transform ELA teaching and learning for the 21st century.

### Technology Use Cultivates Student Learning and Creativity

As demonstrated through the results of the pre/post survey, teachers' value for the use of technology in the classroom increased and they reported that they were using more technology in the classroom than before engaging in the PBI process. This relationship of perceiving value and capacity to change behaviors is supported in the literature. As Zhao and Cziko (2001) assert, teachers are "goal-oriented, purposeful organisms" (p. 6), who will choose not to integrate technology if the need is not apparent to them. It appears that through the PBI process teachers began to see the value that technology could add to their teaching experiences as well as to their students' learning experiences, so ultimately they were willing to expend the effort to transform their teaching approaches.

Obviously the PBI created a new pathway for teacher learning; perhaps more importantly, teachers found it empowering to see their students engaged in new ways. As teachers took risks using new tools and exploring new teaching and learning dynamics in their classroom, their efforts were rewarded as they witnessed how student learning and creativity were expanded. One teacher described aspects of a simple but effective ELA lesson and the subsequent student benefits:

I had my students use Wordle as a small part of a project they were doing with the Bill of Rights. This was such an easy thing to add to the project and the amount of enthusiasm I got in return was priceless. Something so simple can add increased motivation to the students. My students were clearly more engaged, excited, and produced higher levels of writing than in the past. I felt confident that I was on a constructive path.

The capacity for this teacher to see increased student engagement combined with ease of introducing Wordle as a tool contributed to the teacher's self-efficacy for technology integration.

Another teacher observed that creating e-books provided a new type of scaffold for writing: "By creating their own e-books about original stories, my students proved that they are highly engaged when using technology to extend their learning. My students more frequently applied emerging writing skills without support and were eager to practice rereading their work to build fluency for the audio recordings." Several teachers discovered new insights for how technology enabled differentiated instruction for diverse students. According to one teacher, "It was amazing to see how students who are normally very difficult to motivate, become animated and excited about what we were doing. It was something that took time for me to plan out, but it was definitely worth the extra time to see my students become so excited about what they were doing." The added value the technology brought to the learning process for her students outweighed the extra time and effort required in planning to use technology.

Another teacher discovered that her students had important ideas to contribute: "Through my PBI project, I learned how to use Voicethread with my students and they loved it! My students began coming up with new ways that we could use Voicethread to make reading and writing more engaging. I marveled as I witnessed their creativity explode." Another teacher relied on her students to help create her PBI video product:

I enjoyed using the Flip camera to record my students involvement in the lesson. When we started using MovieMaker, I felt overwhelmed and frustrated with the software. After exploring the software and seeking help from my students, I found it to be relatively easy to use. My students collaborated with me on the video production and together we came up with a creative product that we were all proud of.

As these teacher reflections indicate, technology can be a catalyst for igniting both teacher and student learning and creativity. Many ELA teachers were able to enrich and extend curriculum via technology that was highly engaging for their students; however, several teachers expressed concerns about whether they were instilling enough rigor in their lessons. They were aware of how much time was devoted to manag-

ing the technology tools and they were unsure whether they were spending enough time on complex thinking and problem solving skills. It was natural that the teachers would reflect on the balance of rigor and relevance in their lessons since we had immersed ourselves in current literature related to 21st century skills and the need for new skill sets to be successful in a global economy workplace (Dede, 2007; P21, 2008). Obviously, creating engaging lessons so that students can learn with technology tools is essential; equally important is a teacher's capacity to provide ongoing evaluative feedback that ensures that the lessons are intellectually rigorous.

### **Teachers Create a New Educational Future Through Innovation and Leadership**

Through the PBI process we helped teachers understand the range of possible activities they could employ using technology in their lessons; scaffolding became essential as teachers learned how to select and combine activities to achieve specific learning goals for their students. Harris (2008) referred to these activities as "activity structures," which are cognitive structures that experienced teachers use almost ritually to plan and deliver instruction. The range of possible activity structures for using technology was created within the culture of our class through the distributed cognition of the professor, the teacher participants, and the extended network of professionals that were brought into the class either physically or virtually. In this way, the distributed cognition phenomenon that was prevalent throughout the course and specifically the PBI process became the scaffold for teachers to "try on" new activity structures that related to their TPACK. As the teachers tried on new activities, their capacity for innovation as well as leadership evolved.

As Harris (2008) stated, the development of innovative pedagogy "is an additive, recursive, and expansive process, rather than a linear series of replacements of 'old' with 'new'" (p. 269). She deftly compared teaching to a jazz performance—"a well-practiced fusion of careful, creative planning and spontaneous improvisation" (p. 251). One teacher expressed her personal evolution:

When I came to class in the beginning I was hesitant and easily overwhelmed with technology. As my TPACK began to evolve I began to realize I was not being innovative enough with technology. My awareness of tools and the value associated with it blossomed each week. The Flip camera captured my students making a multiplication rap video, which they love watching to this day. As the semester progressed, I found myself being more relaxed as I searched for innovative and creative ways to teach.



Several teachers demonstrated their capacity to provide leadership at their schools. One teacher became an advocate for her students and technology:

As a result of having to do the PBI project, I realized that my computer was not equipped to support the activity I wanted to do. Although I was uncomfortable, I asked my principal if I could receive a new computer that would support the language arts activities that I had planned with my special education students. Much to my surprise, he agreed and I have a new computer with assistive technology to use with my students.

This teacher realized that she needed to be an advocate for innovation in her school and that advocacy included speaking up for what she needed for her students. Another teacher provided leadership through modeling how to use new technologies: "There are countless ways to integrate technology once you are aware of some of the tools. I have found that my fellow teachers now are experimenting with different technology tools that I introduced to them." This teacher demonstrated the ability to bring innovative ideas to her classroom and to her entire school as well.

Igniting new literacies in the classroom is not an easy task, especially since over two thirds of teachers have acknowledged that they are under-prepared to integrate technology successfully (Kajder, 2005). Schools and districts should be intentional in leveraging veteran and novice teachers' skills and talents in tandem (Hervey, 2011). Experienced teachers tend to have richer content and pedagogical knowledge as the result of years of experience in the classroom; likewise novice teachers have the advantage of growing up in a digital age and tend to take more risks in applying technologies in their classrooms. Creating space for formal and informal collaborative relationships will help both veteran and novice teachers effectively scaffolding students' new literacies. Other obstacles include lack of resources, lack of school leadership, and a lack of appropriate assessments that align with new learning expectations (Barone & Wright, 2008). In an attempt to provide a roadmap for ELA teachers as they create 21st century classrooms, the Partnership for 21st Skills recently partnered with the National Council for Teachers of English to create the 21st Century Skills and English Map (P21, 2008). Providing a vision for a new future for education, the map promotes teacher-created models of how 21st century skills can be infused into English classes. The map—which demonstrates how the integration of 21st century skills into English curriculum supports teaching and learning and prepares students to become effective and productive citizens in the 21st century—highlights the critical connections between English and 21st century skills. Following is a sample project set forth by the P21 and NCTE collaboration (P21, 2008):

To integrate 21st century skills at the high school level, teams of students create a virtual fieldtrip for elementary school students. In addition to creating a video and narration detailing the site, students also research background information and interview appropriate experts such as park rangers, tour guides and historians. The students then use a project management tool to organize tasks, assignments and deadlines.

In this example, students assumed shared responsibility for a multifaceted project, demonstrated their ability to work effectively with diverse teams, and illustrated their creativity to plan an interactive fieldtrip for younger students. Through the scaffolding processes embedded within the PBI experience, teachers in our study were able to move forward with designing classroom activities and selecting and using appropriate instructional technologies for teaching and learning within their ELA content. None of the PBI projects were designed and executed at the level of the example above; however, we believe that the teachers now have the foundational attitudes, collaborative skills, and TPACK that will enable them to move forward with more sophisticated projects with their students. As teachers continued to take instructional risks, innovate, and provide leadership, they contribute to forging a new future for education.

## CONCLUSION

Encouraging and supporting educational innovation that allows ELA teachers to engage in teaching and learning with technology in ways never before experienced is both valuable and powerful; many teachers struggle with how to develop “new minds” for 21st century teaching in order to make innovative practices a reality in their classrooms. The implications of this study contribute to our understanding of the nexus of new literacies and TPACK and the types and levels of scaffolding that are effective to propel changes in teacher attitudes, negotiations, and cognitions in order for students to effectively learn with technology. Arguing that we have already passed from the informational age to the conceptual age, Pink (2005) claimed that in addition to left brain-directed reasoning, which was dominant in the information age, right-brain approaches are also essential in the conceptual age in order to be successful. Clearly, 21st century learning and working environments currently reward creative thinkers, collaborators, and synthesizers. Groth, Spickler, Bergner and Bardzell (2009) posited that teachers’ classroom instruction when observed through the lens of the TPACK framework can identify important constructs in their practice. In our study, data suggested that as teachers used technology effectively in their classrooms, student learning and creativity were cultivated. As we venture further into this century, it

remains to be seen if TPACK is indeed the knowledge that is of *most* worth to teachers as they innovate, collaborate, and lead education to a new era. Based on the results of this study, however, it is apparent that TPACK can be scaffolded for ELA teachers, and at a minimum it represents a powerful tool for teachers as they negotiate the rich and complex landscape of new literacies with their students.

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